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function calculation; References; Course 3. Mean field theory of spin glasses: statics and dynamics; 1. Introduction  
 2. General considerations  
 3. Mean field theory; 4. Many equilibrium states; 5. The explicit solution of the Sherrington Kirkpatrick model; 6. Bethe lattices; 7. Finite dimensions; 8. Some other applications; 9. Conclusions; References; Course 4. Random matrices, the Ulam Problem, directed polymers & growth models, and sequence matching; 1. Introduction; 2. Random matrices: the Tracy-Widom distribution for the largest eigenvalue; 3. The longest common subsequence problem (or the Ulam problem); 4. Directed polymers and growth models; 5. Sequence matching problem; 6. Conclusion; References  
 Course 5. Economies with interacting agents  
 1. Introduction; 2. Models of segregation: a physical analogy; 3. Market relations; 4. Financial markets; 5. Contributions to public goods; 6. Conclusion; References; Course 6. Crackling noise and avalanches: scaling, critical phenomena, and the renormalization group; 1. Preamble; 2. What is crackling noise?; 3. Hysteresis and Barkhausen noise in magnets; 4. Why crackling noise?; 5. Self-similarity and its consequences; References; Course 7. Bootstrap and jamming percolation; 1. Introduction; 2. Bootstrap Percolation (BP); 3. Jamming Percolation (JP)  
 4. Related stochastic models  
 References; Course 8. Complex networks; 1. Introduction; 2. Network expansion and the small-world effect; 3. Degree distributions; 4. Further directions; References; Course 9. Minority games; 1. Introduction; 2. The minority game: definition and numerical simulations; 3. Exact solutions; 4. Application and extensions; 5. Conclusions; References; Course 10. Metastable states in glassy systems; 1. Introduction; 2. Mean-field Spin Glasses; 3. The complexity; 4. Supersymmetry breaking and structure of the states; 5. Models in finite dimension; 6. Conclusion; References  
 Course 11. Evolutionary dynamics

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Sommario/riassunto

There has been recently some interdisciplinary convergence on a number of precise topics which can be considered as prototypes of complex systems. This convergence is best appreciated at the level of the techniques needed to deal with these systems, which include: 1) A domain of research around a multiple point where statistical physics, information theory, algorithmic computer science, and more theoretical (probabilistic) computer science meet: this covers some aspects of error correcting codes, stochastic optimization algorithms, typical case complexity and phase transitions, constr

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